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September 20, 2001

RECEIVED

David E. Hilliard 202.719.7058 dhilliard@wrf.com

SEP 2 0 2001

Ms. Magalie Roman-Salas Secretary

FEBRUAL COMPULNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Federal Communications Commission 445 12th Street, S.W.

Washington, DC 20554

Re:

Ex Parte Notification - ET Docket No. 98-153 - Ultra Wideband

**Proceeding** 

Dear Ms. Salas:

This is to note that on September 19, Mimi W. Dawson of this firm and I on behalf of Time Domain Corporation along with Ralph Petroff, President of Time Domain, Jeffrey Ross, Time Domain's Vice-President for Development, and Phillip Inglis met with Commissioner Kathleen Abernathy and her Senior Legal Advisor Bryan Tramont concerning the ultra-wideband proceeding. Except where reflected in the attached materials, the presentation covered matters previously addressed in Time Domain filings made in this proceeding. Copies of the materials provided during the meeting are enclosed. In accordance with the Commission's Rules, an original and one copy of this letter are being filed.

Respectfully,

David E. Hilliard

Counsel for Time Domain Corporation

David E. Hilliard

cc:

The Honorable Kathleen Abernathy (w/encl.)

Bryan Tramont, Esq. (w/encl.)

Enclosure

No. of Copies rec'd OH List A B C D E



Wednesday, August 29, 2001

# Study Reports GPS VulnerableTo Several Types Of Jamming

An as-yet-unreleased study on the vulnerability of GPS (Global Positioning System) shows that satellite networks are vulnerable to disruptions from several causes, including intentional jamming and atmospheric effects. The study, by the Volpe National Transportation Center, makes several recommendations to lessen the impact of such events on the national transportation infrastructure. It appears to pour cold water on FAA's plan to use GPS as a sole-means system, recommending instead the development of affordable backup systems.

DOT and the Defense Department had sponsored the Volpe study after questions were raised in the U.S. and abroad on the wisdom of relying solely on GPS signals when evidence existed that the signals were vulnerable to unintentional and intentional disruptions.

FAA nevertheless forged ahead with a policy that GPS be a sole means system. That appears likely to change, according to a draft press release from the DOT and obtained by The DAILY due to be released next week. First, DOT wants to brief its modal agencies, the White House and congressional committees. The report is scheduled to be discussed at a Sept. 10 Salt Lake City conference, which will include representation by the Volpe Center's Jim Carroll and a DOT response by DOT's Bart Blue.

Although subject to change, the draft press release quotes DOT Secretary Norman Mineta as saying that "this report provides a road-map to addressing possible vulnerabilities in GPS so that we can maintain the highest standards of transportation safety. This department is committed to developing and carrying out a plan based on these recommendations, so that GPS will fulfill its potential as a key element of the nation's transportation infrastructure." Sources said that both U.S. and international interests hope the actual report will spell out the vulnerability problems and what it intends to do about them. An earlier draft report was sent back to Volpe to review the vulnerability aspects, but sources said Volpe refused to water down the implications. According to the draft press release, GPS is susceptible to unintentional disruption from such causes as atmospheric effects, blockage by building and communications equipment, and by intentional disruption.

The report contains a number of recommendations, including continuing the GPS program with higher broadcast power and with the eventual availability of three civil frequencies. Another is to make users aware of the need to mitigate degradation or loss of signal through unintended inferences by communications sources. It also recommends implementing systems to monitor, report and locate unintentional interference, to assess the applicability of military anti-jamming technology and to work with industry to make the technology available for civil uses. The report encourages the development of "affordable systems as backups to GPS."

By Jim Baumgarner, james baumgarner(@aviationnow.com

# **GOVERNMENT AND DEFENSE PROJECTS**

### TIME DOMAIN GOVERNMENT PROJECTS

### National Institute of Standards and Technology Advanced Technology Program

Internal communications and tracking system for medical equipment

### **NASA Johnson Space Center**

 Astronaut / Space Station Extra Vehicular Activity communications and position location and tracking for space walks: Phase II Small Business Innovation Research contract

### **National Science Foundation**

• Universal Home Networking: Phase I Small Business Innovation Research contract

### **Department of Commerce**

• Firefighter locator: Phase I Small Business Innovation Research contract

### **NASA Glenn Research Center**

Phased Array and SAR Radar: Phase I Small Business Innovation Research contract

### NASA Goddard Space Flight Center

• Interspacecraft Communication: Phase I Small Business Innovative Research contract

### NASA Marshall Space Flight Center

Terahertz waveform Cooperative Research and Development Agreement (CRADA)

### TIME DOMAIN DEFENSE PROJECTS

### DoD Military Operations in Urban Terrain Advanced Concept Technology Demonstration

 Through wall radar for military operations in urban terrain to clear buildings by detecting human presence through walls

### Office of Naval Research

• Location and status tracking system for environmental conditions history and shelf life of ammunition in storage depots to circumvent the need for destructive testing and lot sampling

### Office of the Assistant Secretary of the Navy for Safety and Survivability

 Personal, Position, Location, and Tracking System to locate sailors aboard ships during life-threatening situations

### **Army Missile and Aviation Command Advanced Concept Office**

• Over-the-horizon communications link using unmanned aerial vehicles: Phase II Small Business Innovation Research contract

### Army Missile and Aviation Command Weapons Sciences Directorate

Blue Laser research: Phase II Small Business Technical Transfer Research contract

### Army Tank Automotive and Armaments Command Tank Automotive RDE Center

 Terrain mapping radar system to provide ground truthing for Grizzly mine-breaching program: Phase II Small Business Innovation Research contract

### **Army Simulation Training and Instrumentation Command**

 Advanced Tactical Engagement Simulation Program for the Objective Infantry Combat Weapon to detect hits on non line-of-sight targets during military exercises: Phase II Small Business Innovation Research contract

### **Army Simulation Training and Instrumentation Command**

 Cooperative Research and Development Agreement to introduce time modulated ultra wideband technology into military training

### **National Security Agency**

 Technology license for Army Research Laboratory to study how and where time modulated ultra wideband communications should be implemented for the Army

### **Marine Corps**

Personnel Identification System: Phase I Small Business Innovative contract

### **Defense Threat Reduction Agency**

Evaluation of UWB for airborne surveillance and ground penetrating radar

### **Land Warrior Program**

· Evaluation of UWB for Land Warrior Program

### **Army STRICOM**

• Development of Mobile ad hoc networking BAA with military and commercial dual-use capability

### **Army STRICOM**

 Aim-point determination and geometric pairing solution for OICW weapon system: Phase II Small Business Innovative Research contract

### **DoD Office of Science and Technology**

OST IDIQ Program

### Navy Sea Systems Command (NAVSEA)

UWB engineering expertise for technology insertion into Naval Applications

### Navy Research Lab (NRL)

To provide precise timing via wireless

### **COMPLETED PROJECTS**

### Defense Advanced Research Projects Agency Advanced Technology Office

• Self-Healing Minefield program that causes mines to autonomously fill in minefield breaches

### **Army Corps of Engineers**

• Cooperative Research and Development Agreement to mark locations of unexploded ordnance on training ranges, for subsequent munitions clearing

### Army Space and Missile Defense Command Battle Lab

 Wireless communications for Future Operations Center local area network, the next generation tactical operations center

### **Army Simulation Training and Instrumentation Command**

Lightweight Personnel Detection Device to track soldiers during military training exercises

### L3 Communications

Provision of 3 full duplex evaluation PulsON radios with propagation software.

### **Navy Training Command**

 Demonstration of Time Domain's PulsON® radio to track weapons on a training range: Phase 1 Small Business Innovation Research contract

### **Army Material Command**

Proposal to support intelligent mines with PulsON® radar sensor and PLT

### National Telecommunication & Information Agency

Utilization of the PulsON® pulsers to facilitate interference testing in support of the FCC NPRM

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### Johnson Space Center

 Astronaut / Space Station Extra Vehicular Activity communications and position location and tracking for space walks: Phase I Small Business Innovation Research contract

### Army Missile and Aviation Command Advanced Concept Office

 Over-the-horizon communications link using unmanned aerial vehicles: Phase I Small Business Innovation Research contract

### Air Force Rome Labs

UWB SAR Research: Phase I Small Business Innovation Research contract

### Army Missile and Aviation Command Weapons Sciences Directorate

Photonics Research Support: Phase I Small Business Innovation Research contract

### Army Missile and Aviation Command Advanced Concept Office

 Over-the-horizon communications link using unmanned aerial vehicles: Phase I Small Business Innovation Research contract

### Army Tank Automotive and Armaments Command Tank Automotive RDE Center

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### Army Simulation Training and Instrumentation Command

 Advanced Tactical Engagement Simulation Program for the Objective Infantry Combat Weapon to detect hits on non line-of-sight targets during military exercises: Phase I Small Business Innovation Research contract



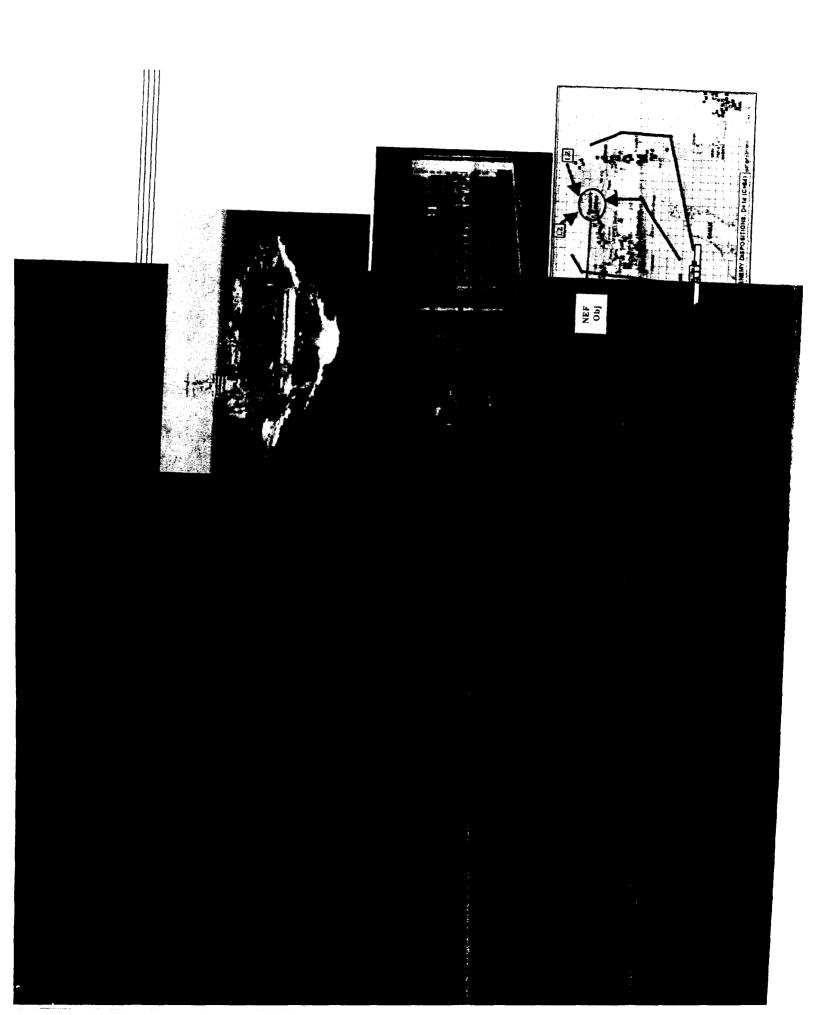
# Ultra Wide Band Applications and Requirements

DARPA NETEX Industry Day McLean, VA

10 Sept 2001

Steven J. Gunderson NFESC Port Hueneme

V (805) 982-1262, Fax (805) 982-4970 steve@nfesc.navy.mil



# **UWB Applications: Logistics**



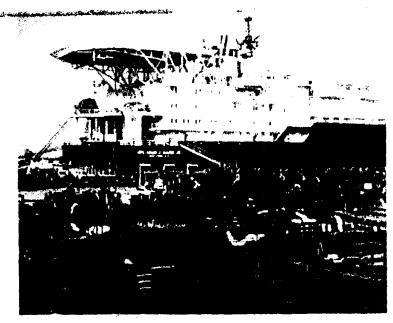
# **Desert Storm**

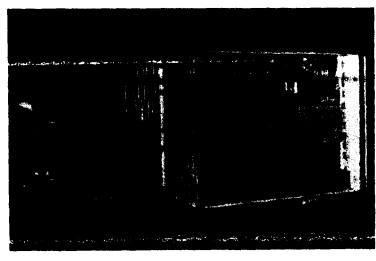
# First MRC with ISO Containers

- 40,000 Containers, Opened 25,000
  - » Paper Manifests Were Inaccurate and Easily Lost
- ISO Containers Hid the Stuff
  - » Previous MRCs Used Break Bulk
- Misplaced & Lost Stuff = \$3 Billion» GAO Report B-246015, Dec 1991

# The BIG Questions

- What Do I Have?
- Where Is My Stuff?
- What Is In the Box?
- What Is Its Condition/History?



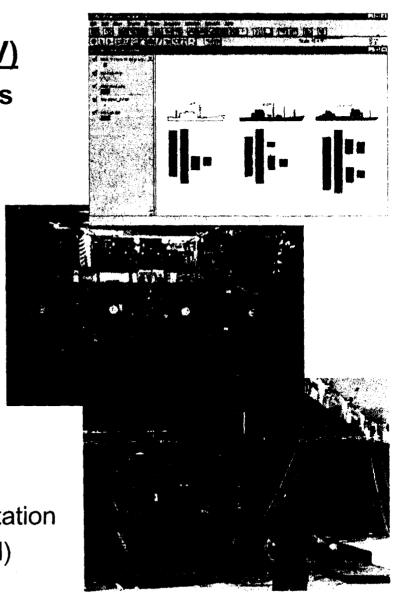


# **UWB Applications: Logistics**



# **Naval Total Asset Visibility (NTAV)**

- Tackle the Unsolved Hard Problems
  - Precision Asset Location (PAL)
    - » Where's my Stuff?
    - » Ship Stow Plans
      - 40% Stow Error, Re-Inventory Required
  - Autonomous Manifesting (AM)
    - » What's in the Box?
    - » The "Holy Grail of Logistics"
  - Infrastructure Reduction (IR)
    - » Cost Reduction (\$K's/Reader)
    - » Ship Pre-Installation and Cabling
- Transportation is a \$1T Industry
  - DoD is Largest Purchaser of Transportation
  - US CINC Transportation (TRANSCOM)

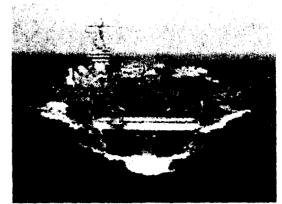


# **UWB Applications: Weapons**



# **Carrier Weapons Management**

- NAVAIR / NAWC Lakehurst
- Problem
  - Aircraft Leave With Partial Loads
    - » Desert Storm: Several Carriers Continuously Launched Aircraft with 2 or Less Weapons
  - Locate Weapon Components for Assembly
     Up to 9 hrs for Assembly: 8 Decks, 32 Mags
  - Locate Weapons in Hanger & Flight Decks
     » Staging Areas, Main Deck, Bomb Farm
- Hot RF Spots Throughout Carrier
  - High Powered Radars: EMI / EMC / HERO
- Proposed Solution
  - UWB Precision Location of Weapon Sleds: 1 ft
- Makes Aircraft Carriers More Lethal







# **UWB Applications: Geolocation**

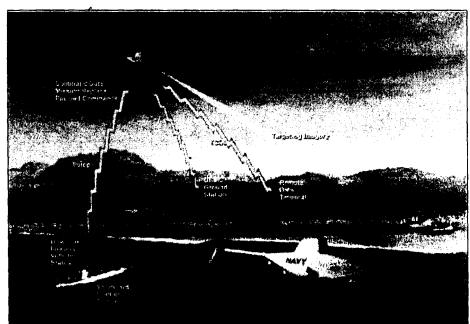


# **UAV Landing System**

- UAV Common Automatic Recovery System (UCARS)
  - Pioneer UAV
  - Microwave: 3 ft Accuracy
  - 6 ft Landing Grid
    - » Pitch / Roll / Stability
    - » Ship Under Way

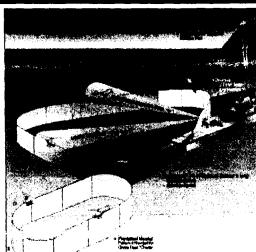
# RQ-8 Vertical Takeoff UAV

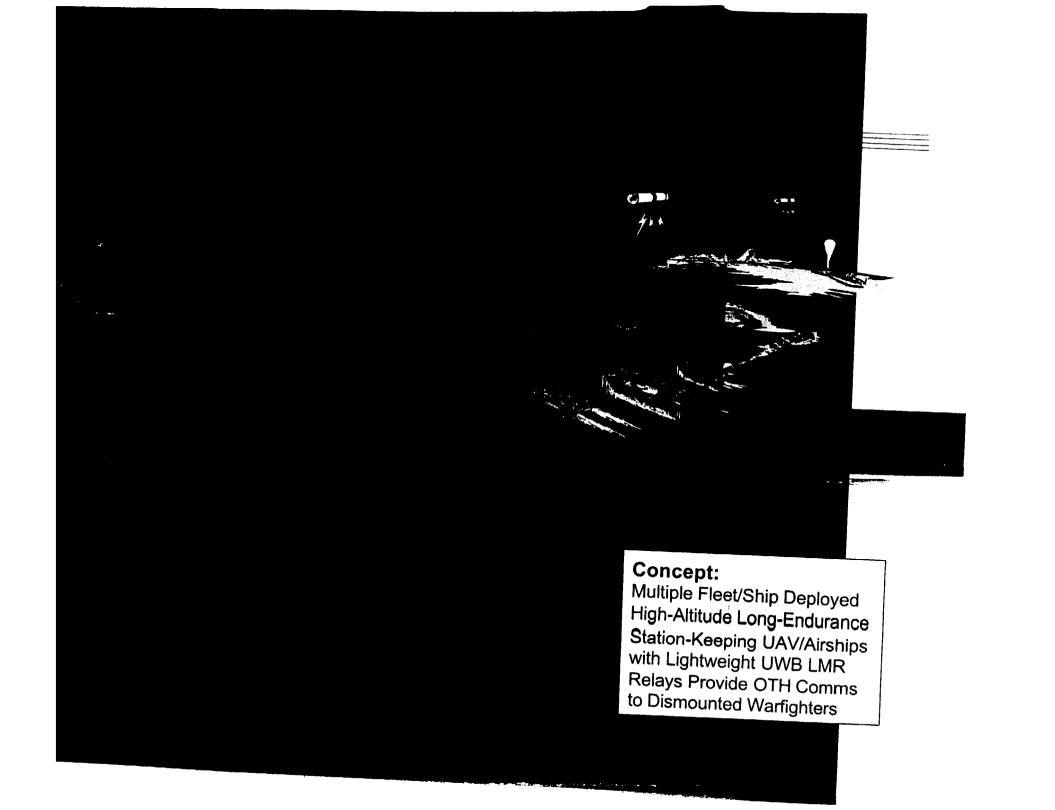
- 3 hrs 150 nmi, 12 hrs Total
- Payload Capacity = 300 lbs
- Comms Payloads
  - » (3) ARC-210 (Aircraft Radio)
  - » TCDL: 14-15 GHz, 10 Mbps
  - » SINCGARS to Ground MEUs









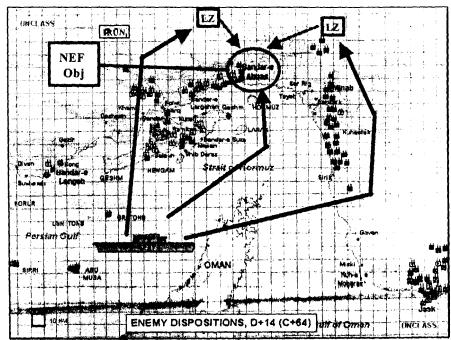


# **UWB Applications: Comms**



# **Marine Corps OMFTS/STOM**

- High Capacity LOS Comms
  - Replace MRC-142
    - » 576 Kb Ship-to-Shore, 25 nm
    - » Losing 1350-1850 MHz Band
- Command Post on the Move
  - Secure Wireless I AN
    - » Connect Servers Within CP
- Convoys on the Move
  - Inter-Vehicle Comms
- Combat ID
  - Geolocation
  - Surface Management
    - » Ship-to-Shore Movement: AAAV & LCAC
- Asset Visibility









DARPA UWB.PPT 9/13/2001 10

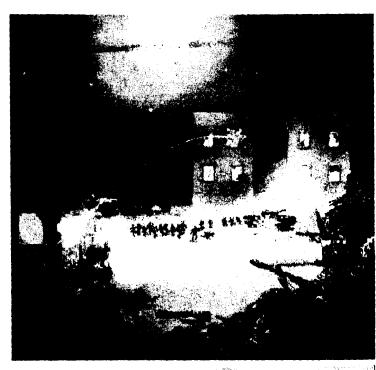
# **UWB Applications: Comms**



# **Urban Warfare**

# MOUT ACTD / USA / USMC

- Frustrated Requirements: C4I
- » R1: Identification of Friendly, Enemy, Noncombatants (IFF)
- » R3: Hands-Free Non-Line of Sight (NLOS) Communications
- » R7: Thru-Wall Sensing
- » R41: Position/Location Inside Buildings
- Military/Com'l Comms Inadequate
  - » Marine Corps Inter-Squad Radios (ISR)
    - ICOM UHF Radios: Non-Secure 16,000 Units
  - » Need Secure Radio, 1-5 Km Range
    - PRC-126 Size, Light Weight (Micro-UAV)
    - C2 for Unmanned Ground Vehicles & Video
- Transition to Proposed Vanguard ATD '03
- Transition to SBCCOM Objective Force Warrior Program







# **UWB Applications: Comms**



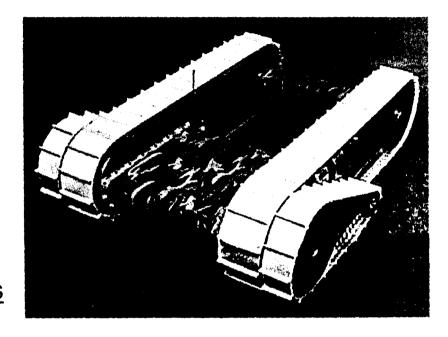
# **Tactical Mobile Robots (TMR)**

# Imperatives

- Tele-Operation
  - » C2, Audio and Video
  - » Robots Talk to Each Other
- Geolocation / Navigation
  - » Robots Find Each Other
- Autonomously Reestablish Comms

# Requirements

- Bandwidth
  - » C2 & Audio (low latency) 25 Kbps
  - » Video (B&W, fuzzy, min) 100 Kbps
  - » Color Video (160x120) 1-2 Mbps
  - » High Res Video (320x240) 3 Mbps
- Range
  - » 500m min (LAN Block Conv), 1-2 Km



- Weight & Power: 1-2 lb, 2-5 W
- Geolocation: 1 cm
  - » Navigation/Mapping/Marsupial
- Environment
  - » Urban: Streets, Buildings, Sewers, Tunnels
  - » High EMI: DC Motors

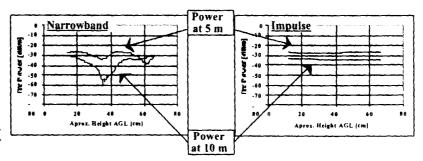
# **UWB** Requirements



# **Advantages**

# · Multi-Path

- Minimize Nulls in Urban Environments
- 1/r<sup>2</sup> -- 1/r<sup>4</sup> -- 1/r<sup>6</sup> Losses
  - » 1 2 Orders Better than Narrow Band
    - Extra Transmitter Power Not Needed: 10-100X



# Co-Interference

- FHSS: SINCGARS -- >2.5 Radios Co-located
- DSSS: Near-Far Power Management -- Qualcomm 1 dB Match Required
- UWB: 40-50 dB Rejection

# · Land Mobil Radio (LMR) / Cellular

- Greater Agility: No Critically Tuned Tanks / Combiners / Splitters
- No Dedicated Reservation Channel

# Interceptibility

- Inherent LPI/LPD/LPE/AJ

### Geolocation

- High Inherent Accuracy: Short Pulse Length ~1 ns = 1 ft
- · Dual Capability: Communications and Geologation Simultaneously

# **UWB** Requirements



# **Architectures**

# Voice

- Inter Squad Radio (ISR)
- Land Mobile Radio (LMR)

# • Data

- Burst Store & Forward
- TCP-IP / Packet
- Ad-Hoc Peer-to-Peer Networks

# Video

- High Data Rate 1-3 Mbps

# Geolocation

- Intra-Squad
- Urban: Bldgs, Streets, Sewers
- Alternate GPS

# Warfighter Requirements

# Works Anywhere

- Urban
- Triple Canopy
- Mountain Terrain
- No Terrestrial Infrastructure

# Quality

- Fast Enough
- Secure: LPI/LPD/LPE/AJ
- 20 30 dB More Link Margin

# Logistics

- Small
- Light
- Cheap

# Conclusion



# **Hunter Warrior AWE**

- Marine Corps Warfighting Lab
  - First AWE, 1997 All Data
  - RMA: Asymmetrical Warfare
- DARPA Provided Technology
  - Land Mobil Radio (LMR)
  - Internet Node In the Sky (INITS)
  - Shared Net: Content Centric
  - ADOCS / LeatherNet (M&S)
  - Surrogates, But They Worked

# Burst Store & Forward

- LMR: Serial, 2.7 Kbps
  - » Short Message: OTH Gold & VMF
  - » 3 Sec on Air, Hard to Locate
- INITS: TCP-IP, 300 Kbps Total



"In This World Where We're Carrying **Mobile Handsets**, I'm Afraid the Communications of
the World's Most Advanced Military Are Operating
at Levels that are 40 Years Out of Date."

Adm. Owens (ret)

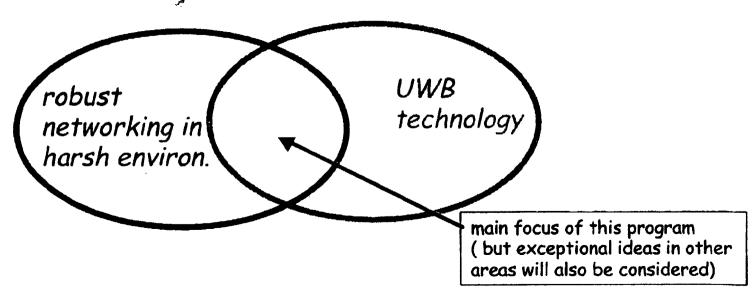
# Networking In the Extreme (NETEX) Program

Industry Day Sept 10, 2001

Mari Maeda
Program Manager
Information Technology Office
DARPA

# Program Goal

Robust and <u>rapid</u> wireless networking in <u>complex</u>, <u>hostile</u> environments using UWB technology



- robust immunity to fading/outages
- ·complex harsh settings, urban, indoor
- ·hostile low probability of jam/detect
- ·rapid on-the-fly networks, no spectrum assignment

# Why Harsh Environments

- Dense urban terrain represents the single most hazardous setting for engagement
- Casualty rate extremely high
- Increasing shift of world population to cities
   85% of world population by 2024
- · GPS often ineffective
- Need to protect our forces, remove personnel from areas of high threat, deploy sensors & robots
- Other harsh settings: on ships, inside cargo containers, close to the ground...

# UWB Claims

- No fading from destructive interference (coherent effects are less)
- Potential for single chip, all digital (cost savings)
- Lower power dissipation (few analog components)
- Built-in LPI/LPD/LPJ
- No need to get spectral allocation (uwb signal is buried in the noise)
- Penetration capability walls, ground (enabled by low frequency component)
- High precision ranging (enabled by high frequency component)

12

- · Focus on the real advantages of UWB
- Design and implement <u>next-generation</u> UWB hardware and software for ad-hoc networking in extreme environments.
- Develop uwb network-based geolocalization system
- Demonstrate key DOD applications in appropriately harsh, environments

# Technical Areas

# Precision Geo-Localization

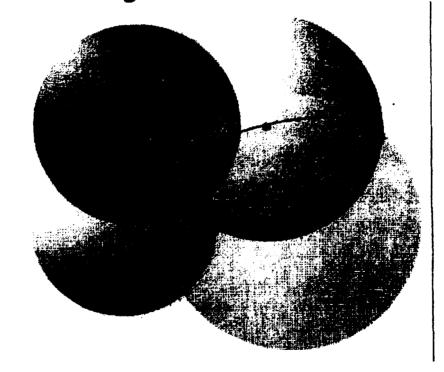
· 3-D multi-lateration

· scalable and power-efficient geolocalization

techniques

in-depth tradeoff
 analysis
 (accuracy vs.
 power, number of nodes ..)

· mobility support







# Ultrawideband (Impulse Radio) Communications Technical Challenges

**NETEX Industry Day** 

10 September 01

Dr. James A. Freebersyser
Program Manager, DARPA/ATO
(703) 696-2296
jfree@darpa.mil



# **Potential Advantages of UWB**



- Ultrawideband Operation (> 1 GHz)
  - Better multipath fading performance (like any wideband signal would)
  - Large processing gain (> 40 dB) improves Anti-Jam (AJ) properties
  - Covert operation (Low Probability of Intercept/Detection (LPI/D))
  - Position location on the order of a few centimeters
- Greatly Reduced Power Consumption
  - Single chip (CMOS) implementation without mixed signal processing
  - Low duty cycle operation
  - Higher energy efficiency due to pulsed battery operation
- More Efficient Use of the Spectrum
  - More users per unit of bandwidth
  - Unregulated (FCC Part 15) operation
  - Reduced near-far interference resulting from low duty cycle operation
  - Full-duplex operation in the same frequency band

The Potential of UWB Impulse Radio Has Not Been Realized



# **Summary/Conclusion**



- Ultrawideband What's Old Is New Again!
  - Wireless could have gone straight to UWB if DSP had been available ©
- A Cornucopia of Commercial and Military Applications
  - Communications, radar, geolocation, automation, measurement, etc.
- UWB Has The Potential for Revolutionary Change
  - Regulatory changes (FCC Part 15?) are needed
- UWB Research Has Only Just Begun
  - Propagation, antennas, circuits, devices, waveforms, signal processing, radio architectures, MAC/network protocols, etc.